

MANAGING URBAN WATERSHED PATHOGEN CONTAMINATION

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A watershed is an area in which water, sediments, and dissolved material drain into a common outlet, such as a river, lake, bay or ocean.

BACKGROUND

This presentation is a summary of the EPA National Risk Management Research Laboratory (NRMRL) publication entitled Managing Urban Watershed Pathogen Contamination, EPA/600/R-03/111 (September 2003). It is available on the internet at <http://www.epa.gov/ednnrmrl/repository/water.htm>. Pathogens, disease causing microorganisms, are a major concern for managers of water resources. Once in a water body, pathogens infect humans through consumption of contaminated fish and shellfish, skin contact, or ingestion of water. Protection from pathogen contamination is most important for waters designated for (1) recreation, (2) public water supplies, (3) aquifer protection, and (4) protection and propagation of fish, shellfish, and wildlife. The document provides information to support specific steps of the total maximum daily load (TMDL) process for meeting water quality standards for microorganisms in urban watersheds. The regulation of waterborne pathogens, detection methods, combined sewer overflow control technologies, and stormwater best management practices are discussed. Also presented is an evaluation of microbial indicators for estimating the presence of pathogens and likelihood of the occurrence of outbreaks.

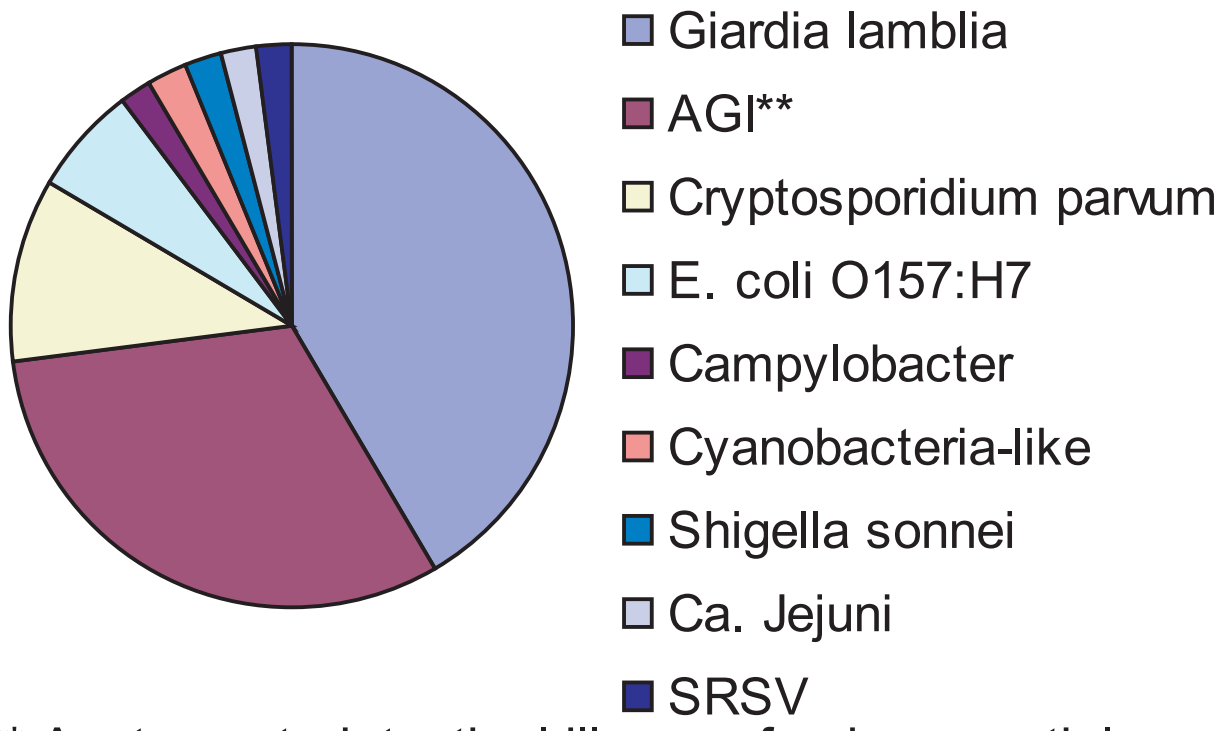
WATERBORNE PATHOGENS

- Bacteria, protozoa, virus, helminth, fungus
- Transported by stormwater runoff, combined and sanitary sewer overflows, wastewater treatment plant effluents, combined animal feeding operations
- Majority of large scale pathogenic waterborne outbreaks attributed to human contamination
- Leading cause of impairment for rivers, streams, and ocean shorelines



Stormwater BMP

Microbial Pathogens Attributed to Outbreaks of Illness from Exposure to U.S. Surface Drinking Water Sources, 1986-2000. (Total 48 Outbreaks)



** Acute gastrointestinal illness of unknown etiology

DETECTION METHODS

- Bacterial indicators monitoring is less expensive, easier, and more common than measuring pathogens directly
- Indicator bacteria make poor proxies for viruses and protozoa
- Membrane filtration or multiple tube fermentation are most common methods employed in the U.S.
- Clinical testing of individuals identifies microorganisms responsible for waterborne outbreaks
- Microbial source tracking and pathogen detection methods investigate possible sources of contamination

BACTERIAL	PROTOZOA	VIRAL
<ul style="list-style-type: none">cultural & enzyme basedimmunologicalgenetic	<ul style="list-style-type: none">immunologicalgenetic	<ul style="list-style-type: none">culturalimmunologicalgenetic

EVALUATION OF PATHOGEN INDICATORS

- Fecal coliform has historically been the microbiological indicator of choice, but is being replaced by the more specific indicators *Enterococcus* and *E. Coli* for fresh waters, and *Enterococcus* for marine waters
- Review of epidemiological studies found *Enterococcus* to be indicator most strongly correlated with gastrointestinal illness
- The pie chart shows pathogens identified as causing outbreaks of gastrointestinal illness

PATHOGEN DISINFECTION TECHNOLOGY

- Point sources of pathogens, e.g., CSO, sanitary sewer overflow (SSO), collected stormwater, and urban runoff, can be effectively disinfected
- CSO is more frequently disinfected than any other point source (National CSO Control Policy)
- Predominant technology in use is chlorination/dechlorination
- Because of health risks from chlorination, alternative technologies are tested - UV has been already used



Stormwater BMP - Wet Pond

BEST MANAGEMENT PRACTICES (BMP)

- Diffuse sources of pathogens are managed by use of structural and nonstructural BMPs
- Reduction of pathogens is a secondary function of BMPs and not always reported
- Examples of structural BMPs are wet ponds, dry ponds, constructed wetlands, filters, rooftop storage, swales, eliminating illicit cross connections, and reducing stormwater volume
- Pathogen removal is most frequently reported for sand filters, wetlands, and wet detention ponds; however the data are scarce and the results are highly variable
- Nonstructural BMPs are good housekeeping practices designed to reduce or prevent pollutant deposition in a watershed, e.g., public education or regulations
- Limited quantitative data is available on the effectiveness of nonstructural BMPs for reducing microorganism concentrations in receiving waters

REGULATIONS

- Clean Water Act (CWA) Section 303(c) requires states to adopt water quality standards
- For pathogens, standards are generally microbial indicators
- CWA Section 303(d) requires each state to develop a list of impaired waters, and develop a pollutant specific TMDL for each impaired water body
- CWA Section 305(b) requires states to assess the health of their waters, identify pollutant sources, submit reports every two years to U.S. EPA describing water conditions (see table for 1999-2000)
- As authorized by the CWA, the National Pollution Discharge Elimination System (NPDES) permit program regulates point sources that discharges pollutants into U.S. waters. Most urban stormwater discharges are considered point sources and regulated under NPDES
- Safe Drinking Water Act (SDWA) states that maximum contaminant level goals (MCLG) are zero for pathogens
- SDWA 1986 and 1996 Amendments focused attention on source water protection

U.S. Microbial Water Quality Assessments Summary – 1999 and 2000	
Rivers and Streams	<ul style="list-style-type: none">19% of U.S. river and stream miles assessed39% of assessed river and stream miles impairedPathogens (bacteria) are leading cause of impairmentAgriculture is the primary source of impairment
Ocean Shorelines	<ul style="list-style-type: none">6% of U.S. ocean shoreline miles assessed14% of assessed shoreline miles impairedPathogens (bacteria) are leading cause of impairmentUrban runoff/storm sewers are primary source of impairment
Great Lakes Shorelines	<ul style="list-style-type: none">92% of U.S. Great Lakes shoreline miles assessed78% of assessed shoreline miles impairedPathogens (bacteria) are third leading cause of impairmentContaminated sediments are the primary source of impairment
Estuaries	<ul style="list-style-type: none">36% of U.S. estuarine square miles assessed51% of assessed estuaries square miles impairedPathogens (bacteria) are fourth leading cause of impairmentMunicipal point sources are primary source of impairment
Lakes, Reservoirs, and Ponds	<ul style="list-style-type: none">43% of U.S. lake, pond and reservoir acres assessed45% of assessed lake acres impairedPathogen (bacteria) are not a leading cause of impairmentAgriculture is the primary source of impairment

U.S. EPA, 2002. *National Water Quality Inventory – 2000 Report*, EPA-841-R-02-001. Office of Water, Washington, DC.

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